



## **Weather, climate, and resource Information should meet the needs of Sahelian pastoralists**

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PRELIMINARY ACCEPTED VERSION

# **Weather, climate, and resource information should meet the needs of Sahelian pastoralists**

## **Abstract**

There has been an increasing focus on providing better weather, climate, and resource information for decision making in drylands. This study explores what kind of information pastoralists in the Sahel received in 2013 and how they responded to this information. Moreover, the study assesses whether the disseminated information corresponds to the actual needs of pastoralists. The overall objective is thus to identify the outcome of providing weather, climate, and resource information to pastoralists and thereby to explore whether and how various products may guide their mobility and decision-making patterns. The results show that few of the interviewed pastoralists receive the seasonal rainfall forecasts, which have been produced since 1998 by the Climate Outlook Forum for West Africa. The pastoralists who did receive the forecasts used the information to adjust their crop cultivation strategies rather than to support livestock management decisions. To do the latter, pastoralists need information pertaining to the availability of grazing resources in various areas, the onset date of the rains, flooding events, and fine-scale information on rainfall amount during the first weeks of the rainy season. Such information could be used to adjust the purchase of supplementary fodder, to make qualified choices on transhumance destinations and to make changes in herd composition. As pastoralists primarily acquire this information by calling friends and family in nearby areas, the results point to a strong disconnect between the parameters and scale of information that pastoralists need and those currently provided.

## **Keywords**

Herd management; Sahel; supplementary fodder; transhumance; user response; weather forecasts

## 1. Introduction

In many drylands of the tropics, agricultural and pastoral systems have adapted to erratic weather patterns, including droughts, excessive rainfall, strong winds, and temperature extremes, which are the main challenges for crop and livestock production (Mertz et al., 2009; Mortimore & Adams, 2001). Climate change is likely to exacerbate these conditions (IPCC, 2007) and consequently there has been an increasing focus on providing better weather and seasonal climate information to farmers in order to improve decision-making (Crane et al., 2011). Prominent studies from Africa, however, have pointed to a strong disconnect between the parameters and scale of the climate and weather information that African villagers need and those of scientific forecasts (Ingram et al., 2002; Luseno et al., 2003). It has, for example, been suggested that most villagers are more interested in down-scaled forecasts of the duration and distribution of seasonal rainfall than in the currently available forecasts of the total amount of seasonal rain. Predictions of the onset and the end of the rains and water deficit periods during the season may thus be some of the products of high value at the local level in Africa (see e.g. Ingram et al., 2002). While such information needs have been highlighted for African small-scale farmers, very few studies are available on the information needs of the estimated 50 million pastoralists in sub-Saharan Africa (Weibel, 2010). Moreover, 65% of global drylands consist of grassland used for livestock production as these areas often are marginal for agriculture because of low or erratic rainfall or flood risks (Mortimore, 2009).

In East Africa, a few studies have assessed the type of information pastoralists are assumed to be interested in (Luseno et al., 2003; Kaitho et al., 2007). Kaitho et al. (2007) used real-time satellite weather data to simulate daily forage conditions and near-term forecasts of these conditions, while Luseno et al. (2003) suggested that timely information on forage supplies might be of value. In the

1 West African Sahel, no studies have so far explored information needs among pastoralists. Hence,  
2 this study will focus on the user group of Sahelian pastoralists, and the first aim is to identify the  
3 relevance of the currently available seasonal rainfall forecast compared to other types of  
4 information. As farmers and pastoralists from a practical point of view tend to be concerned with an  
5 annual time scale rather than longer time periods (Adger et al., 2003), the focus is on  
6 meteorological information and intra-seasonal and seasonal climate information instead of decadal  
7 and long term climate information. Pastoralists, however, most likely need more than just  
8 information pertaining to the rainfall of the next season. They are also likely to be interested in non-  
9 meteorological information, such as the availability and quality of grazing resources, and sources of  
10 water. Thus, this paper looks at weather information, intra-seasonal and seasonal climate  
11 information, and resource information.

12  
13 Due to the apparent knowledge gap concerning pastoralists' information needs, it remains also  
14 unknown how pastoralists would actually use different types of weather, climate, and resource  
15 information. This gap is worrying as the value of the information ultimately depends on whether or  
16 not people respond to the available information (Vogel & O'Brien, 2006). Recent literature on the  
17 utility of climate information has suggested that knowledge producers regard their product as useful  
18 when they have engaged in the research they think users need (Lemos et al., 2012). But because the  
19 users' decision-making processes and contexts are not completely understood the knowledge  
20 produced remains often underutilized. Users, in turn, may have unrealistic expectations of how  
21 knowledge fits their decision-making, so although all forms of user-inspired knowledge are in  
22 principle useful, they are not always usable, unless users and producers take specific steps to make  
23 them so (Dilling & Lemos, 2011). In this context, Cash et al. (2003) have argued that information  
24 is usable only if perceived by users as salient, credible and legitimate. Yet, even as these conditions

are met, information must be accessible and actionable for it to be incorporated into user's adaptive decisions (Hansen et al., 2011). This highlights the critical role of interaction between producers and users in order to overcome the barriers to usability.

A few studies have assessed how African farmers have used or are likely to use weather, climate, and resource information. A number of these evaluations have been based on theoretical models (Roudier et al., 2011; Ziervogel et al., 2005; Sultan et al., 2010; Thornton, 2006), while Roudier et al. (2014) employed a participatory approach to simulate possible responses among farmers in Senegal. Roncoli et al. (2009) and Ingram et al. (2002), on the other hand, studied actual response options to seasonal forecasts among farmers in Burkina Faso. These studies suggested that people may change crop variety, planting date, field size, and fertilizer use, or that they may relocate fields, start storing and selling food, and diversify from farming to non-farming activities. However, these studies have some limitations. Firstly, too few strategies might have been taken into account (Meza et al., 2008). Secondly, a narrow focus on the linkage between seasonal forecasts and for example the chosen crop varieties could prevent researchers from learning how people use seasonal forecasts in combination with other types of weather and climate information. Thirdly, production decisions by African farmers as well as pastoralists may be shaped by many environmental, agronomic and economic factors beyond weather, climate, and resource information (Roncoli et al., 2009; Crane et al., 2011; Bryan et al., 2009; Lenton, 2013; Mertz et al., 2010).

Hence, these studies point to a need for research on both the relevance and use of weather, climate, and resource information, especially among pastoralists. In addition to identifying the relevant information for West African pastoralists, this paper thus aims to improve the understanding of how and why pastoralists use available information in the way they do, and how they might use other

1 types of weather, climate, and resource information. By doing so, the overall objective is to identify  
2 the actual outcome of providing different types of weather, climate, and resource information to  
3 pastoralists, and thus to assess whether and how various products can guide the mobility and  
4 decision-making patterns of pastoralists.

## 6 **2. Weather, climate, and resource information context**

7 The research efforts on identifying and communicating relevant weather, climate, and resource  
8 information to local end-users in West Africa – i.e. small-scale farmers – have mainly been carried  
9 out by the Climate Forecasting for Agricultural Resources (CFAR) project (Ingram et al., 2002;  
10 Roncoli et al., 2000; Roncoli et al., 2001; Kirshen & Flitcroft, 2000). The CFAR project was a  
11 research initiative aimed at identifying opportunities for and constraints to the application of  
12 seasonal rainfall forecasts to improve agricultural production and livelihood security in West  
13 Africa. Emphasis was on seasonal rainfall forecasts delivered by the Climate Outlook Forum for  
14 West Africa PRESAO (PREvisions Saisonnières en Afrique de l'Ouest), which has issued seasonal  
15 rainfall predictions (with 1- to 2-month lead times) since 1998 (Tarhule & Lamb, 2003). The  
16 Climate Outlook Forum was launched by a consortium that included a number of regional  
17 institutions, such as the Centre Regional de Formation et d'Application en Agrométéorologie et  
18 Hydrologie Opérationnelle (AGRHYMET), the African Centre of Meteorological Applications for  
19 Development (ACMAD) and the Niger Basin Authority (NBA) as well as international partners  
20 such as the UK Met Office, Météo-France and the International Institute for Climate and Society  
21 (IRI). Each year in May the consortium and experts from the region's National Meteorological and  
22 Hydrological Services create seasonal forecasts for dissemination to relevant stakeholders. The  
23 seasonal forecasts are based on a 30-year rainfall record and formulated as the probability of the  
24 rainfall being like the driest 10 years, the middle 10 years, or the wettest 10 years (Patt et al., 2007).



1  
2 After the seasonal forecast is created, the National Meteorological and Hydrological Services  
3 present the forecast information relevant to each country to the *Groupe de Travail*  
4 *Pluridisciplinaire* (GTP) as well as other related multidisciplinary working groups. The group  
5 composition varies among countries, but the GTP generally consists of representatives of various  
6 government agencies (e.g. the Ministry of Agriculture), international organizations (e.g. World  
7 Food Program), and research institutes (e.g. the International Agriculture Organization (IAO)).  
8 Decisions regarding the national forecast and courses of action are reached by consensus, and the  
9 forecast is then released to the media (Tarhule & Lamb, 2003). Agricultural field extension workers  
10 collaborating with the GTP may carry the forecast information to the village level for  
11 dissemination. However, the dissemination system is characterized by discontinuities as there is no  
12 formal dissemination strategy or follow-up to ensure that the information actually reaches farmers  
13 and pastoralists. Likewise, limited effort is made to obtain feedback from farmers and pastoralists  
14 on how the forecasts are received and utilized.

15  
16 The CFAR research project carried seasonal forecasts to the village level in Burkina Faso in the  
17 early 2000s. In 2000, villagers from the CFAR study sites participated in the Climate Outlook  
18 Forum held in Ouagadougou, and during a workshop, scientists from the CFAR project explained  
19 the forecast to the villagers (for a more detailed description see Ingram et al., 2002). This step was  
20 an early pilot phase of the project, while the main experimental dissemination was done at the onset  
21 of the 2002 and 2003 rainy seasons. The dissemination efforts included farmer workshops, village  
22 meetings, radio broadcasts, and flyers in the local language. By the end of the two rainy seasons  
23 CFAR researchers conducted fieldwork at the village level and a final workshop was held in 2007.

24

The seasonal forecast for 2013 is shown in Fig. 1, and it was stated that ‘*Near average or above average precipitation is very likely over western Sahel from Mauritania and Senegal to western and central Niger. About 80% to 130% of normal precipitation is expected over much of this zone*’ (ACMAD et al., 2013). Along with the seasonal forecast, the Climate Outlook Forum for West Africa provided a list of 22 recommendations, of which 18 were related to crop cultivation and the following four were related to pastoral activities:

1. *Prepare for a more extensive collection and storage of fodder*
2. *Keep animals away from river banks to avoid drowning*
3. *Plan for more vaccines and drugs for water related diseases*
4. *Plan for a late transhumance*

### **3. Pastoral behavior context**

The pastoralists of dryland West Africa have a diverse range of decision options to the risks and uncertainty they face in their daily life. Such risks include fluctuating livestock prices, climate variability, and a highly varying natural resource base (Toulmin, 1994). This study will focus on decisions that relate to weather, climate, and the natural resource base. Emphasis is on the following three categories of decisions:

- Decisions related to herd location and transhumance
- Decisions related to the possible use of supplementary fodder
- Decisions related to buying and selling of livestock.

The three categories are obviously interrelated, since moving livestock to areas where fodder is available may be an alternative to buying supplementary fodder, and selling livestock may become relevant if means of providing fodder are not available.

1  
2 Regarding the first category, Sahelian pastoralists cover a spectrum from ‘free nomadism’ to  
3 sedentary systems that might be supplemented with emergency transhumance during droughts  
4 (Adriansen & Nielsen, 2005). Between these ends of the spectrum, other types of pastoralist  
5 behavior include firstly, the seasonal transhumance, whereby pastures around a permanent  
6 residence are replaced by pastures in other areas during either the dry or rainy season and secondly,  
7 the year-round small-scale movements around a permanent residence. The information needs may  
8 differ greatly between pastoral communities in different ends of this spectrum. In general, pastoral  
9 mobility is believed to be gradually diminishing in the Sahel because of constraints imposed by an  
10 expanding cultivated area as well as changes in land tenure systems and in labor availability  
11 (Powell et al., 2004). However, the considerable benefits of maintaining high mobility imply that  
12 this trend may also be reversed. Adriansen (2006) has, for example, shown increased mobility in  
13 commercialized pastoral systems based on small-stock production. Land reforms designating  
14 pastoral areas such as grazing lands, livestock corridors and resting areas have also improved  
15 conditions for livestock mobility and reduced conflicts in the Sahelian ecological zone, though less  
16 so in the more intensively farmed areas of the Sudan and Guinean ecological zones (Mertz et al.,  
17 2010).  
18  
19 Related to the second category, supplementary fodder such as millet bran and rice bran used to be  
20 perceived as ‘emergency feeding’ in times of drought (Toulmin, 1994). However, during the past  
21 decade, the conservation of crop residues from the fields has become a more permanent strategy  
22 among both pastoralists and farmers as a result of the increased grazing pressure on the common  
23 grazing lands (Rasmussen & Reenberg, 2013; Powell et al., 2004). By preserving the crop residues  
24 after harvest, each household secures a certain quantity of fodder for the livestock.

1  
2 Concerning the third category, buying and selling of livestock, destocking has, like the purchase of  
3 supplementary fodder, been associated with droughts. Destocking early in a drought cycle has been  
4 encouraged by national policies as well as by NGOs, since holding on to animals as drought  
5 conditions intensify might be a risky strategy (Toulmin, 1994). The relevance of destocking should,  
6 however, not only be seen in a drought context. Rather, destocking may also be a recurrent strategy  
7 embraced by pastoralists with the aim of purchasing food for the family (Turner & Williams, 2002).  
8  
9 How pastoralists embrace these three categories of decisions will vary greatly depending on the bio-  
10 physical environment, especially the spatio-temporal distribution of water and vegetation resources,  
11 the access and property rights to these resources, the degree of involvement in a market economy,  
12 and the cultural norms of specific ethnic groups. Moreover, decisions will most often be based on  
13 incomplete information on climate, weather, and the status of the natural resource base. As  
14 decisions are not only taken in times of drought, it is evident that information on climate, weather,  
15 and resources could improve the decision making. As water and vegetation resources are often non-  
16 limiting in the rainy season, the critical decisions made by pastoralists are mainly associated with  
17 the dry season and, accordingly, information demands of pastoralists are expected to concentrate on  
18 the availability of water and vegetation resources in the dry season. However, a few exceptions  
19 exist as conditions during the rainy season certainly have an impact on the availability of grazing  
20 resources during the dry season. Firstly, in relation to destocking pastoralists may be interested in  
21 knowing if the rainy season is going to be relatively wet or relatively dry. Secondly, there is a  
22 possible need for information on the northward advance of the monsoon, as such information will  
23 support decisions on when and if pastoralists should migrate southwards to 'meet' the rains  
24 (Adriansen, 1999) as well as decisions on whether it is necessary to buy supplementary fodder

while awaiting monsoon rains. To summarize, the information needed to support pastoralists' decisions on transhumance, the purchase of supplementary fodder, and destocking and restocking is assumed not only to relate to coarse-scale drought predictions, but also to include up-to-date, fine-scale information on water and vegetation resource availability.

#### 4. Study area

The study was carried out in the northern part of Burkina Faso among *Fulbe* households (*Fulani* in the English-language literature and *Peuls* in the French-language literature), who are predominantly pastoralists whose principal form of property is cattle. The villages of Koria and Belgou in the Seno province were selected. Koria had also been used as a study site in the CFAR project (see e.g. Ingram et al., 2002; Roncoli et al., 2000), and the present study aimed to illustrate possible differences in information needs between a village where seasonal rainfall forecasts had been distributed and a village where the awareness of seasonal rainfall forecasts was likely to be more limited. The location of the study sites is shown in Fig. 2.

Rainfall is a major constraint for both agriculture and livestock production in the region with a rainy season of only five months, from May to September. The closest meteorological station to the two sites is Dori. The average annual rainfall in Dori ranged from 600 to 700 mm in the 1950s and 1960s, but declined to 400-500 mm during the 1970s and 1980s. During the 1990s and 2000s average annual rainfall increased again, but greater annual variations in precipitation were observed (Proud & Rasmussen, 2010). A study of rainfall in villages of the nearby Oudalan Province also showed a decline in August rainfall, which is crucial for crops and vegetation, in the first half of the 2000s compared to the previous decade (Mertz et al., 2012).

1 The *Fulbe* household is typically composed of a man, his wives, and their children. They live in  
2 small separate camps, which are generally located in the periphery of sedentary village communities  
3 (Diallo, 2012). This structure is especially present in Belgou, where the village is primarily  
4 inhabited by the sedentary *RimayBé* but with scattered settlements of *Fulbe* households about 2 km  
5 from the main village. Koria, on the other hand, has six *quartiers*, two of which are the homes of  
6 *Fulbe* pastoralists.

7  
8 All members living in a pastoralist camp are under the legal authority of the head of the family, who  
9 is the oldest man. The head of the family makes decisions on transhumance destinations, the buying  
10 and selling of livestock and the purchase of supplementary fodder. Cattle herding is an exclusively  
11 male activity, in which adult men manage herds and children as well as adult men are herders.  
12 During the dry season, households may choose to divide a herd into satellite herds and milk herds.  
13 The milk herds are kept close to the *Fulbe* settlement as the cattle produce milk for consumption,  
14 while the satellite herds move depending on the available pastures. During the rainy season, the  
15 most widespread strategy is to graze both satellite herds and milk herds in the vicinity of the village.

16  
17 Many *Fulbe* households combine transhumant pastoralism with some crop production during the  
18 rainy season. Pearl millet is the main staple crop in the Sahel and is grown mostly on sandy soils.  
19 Medium-duration sorghum varieties, which ripen before local millet varieties, are also planted,  
20 especially in valley bottoms and on clayey soils that were previously used for pasture.

## 21 22 **5. Methodology**

23 Field work was carried out in October 2013 and multiple methods were used at each of the two  
24 study sites.

1

## 2 **5.1 Survey**

3 A survey was conducted with 30 heads of household in Koria and 31 heads of household in Belgou.

4 The questions covered pastoral strategies relating to the household unit and not the individual

5 household members. In Belgou, all *Fulbe* households living in the periphery of the village were

6 interviewed, seven of whom had arrived within the past three years, primarily due to the gold

7 deposits in the surrounding areas. In Koria, the respondents were selected to represent the two

8 pastoralist *quartiers* of the village. The survey provided a broad base of information, which was

9 useful in establishing a contextual framework or a baseline for the two villages, for example, on the

10 level of education and the assets owned (see Fig. 3). Moreover, the survey explored how the

11 households acquired weather, climate, and resource information and their pastoral strategies, such

12 as the sale and purchase of livestock, the use of different fodder resources, and engagement in

13 transhumance. The aim was to have a questionnaire design that facilitated the exploration of

14 possible associations between variables like the weather, climate, and resource information received

15 and engagement in transhumance.

16

17 All interviews were carried out with the help of a local assistant in the respondents' homes. Each

18 interview lasted approximately two hours.

19

20

## 21 **5.2 Semi-structured interviews**

22 In Koria and Belgou, the semi-structured interviews were conducted with pastoralist households –

23 either the head of the household, the eldest son, or the wife. In total, 22 interviews in Koria and 21

24 interviews in Belgou were conducted. Fifteen of the interviewees from each village had also

1 participated in the survey and they were selected to represent differences in age, education and  
2 assets (radio, TV, telephone) within the village. The heads of household, who had participated in  
3 the survey, were divided into three main age groups: young, middle-aged, and elderly. It was  
4 attempted to have approximately the same number of interviews with individuals belonging to each  
5 age group. The remaining interviews were carried out with other household members than the heads  
6 of the household. They were selected randomly from the pool of households who participated in the  
7 survey. The sample included women as well as young and middle-aged men who were about to  
8 become the head of household.

10 The interviews lasted approximately two to three hours and they took place in Fulfulde, the local  
11 language. An important aim of the semi-structured interviews was ascertaining how pastoralists  
12 used or would use various types of weather, climate, and resource information. Respondents were  
13 asked, for example, what they would do if they had access to information on the start of the rainy  
14 season in various areas. They were also asked whether they had received seasonal forecasts and  
15 what other type of information they found relevant. Visual aids were also employed during  
16 interviews, namely, a laminated map of the 2013 seasonal rainfall forecast was used to discuss  
17 respondents' interpretation as well as use of the forecast.

### 21 **5.3 Focus group discussions**

22 Eight focus groups, four in each village, were carried out. The discussions lasted approximately two  
23 hours and the groups consisted of 7-10 persons who were either already or soon to become heads of  
24 household. These participants were selected according to age as the use and knowledge of different



1 information channels may be confounded with age, so focusing exclusively on, for example, elderly  
2 pastoralists was likely to result in an age bias. As a focus group is a research technique that collects  
3 data through group interaction on a topic determined by the researcher (Morgan, 1997), the groups  
4 were initiated by a collective activity guided by the researcher. Although the initial focus was given,  
5 the group was allowed to discuss other issues within the scope of the discussion. During all focus  
6 groups a sketch of the group configuration was drawn, indicating, for example, the participants'  
7 names, ages, other relevant characteristics, and their position within the group. This configuration  
8 helped in trying to differentiate between individual speakers when going through the notes. The last  
9 topic of each discussion was to raise any unresolved issue that the researcher had identified for the  
10 group to confirm or clarify.

11

12 While one focus group was conducted prior to the survey and the interviews, the remaining three  
13 took place towards the end of the fieldwork. Due to the selection of heads of household as  
14 participants, the majority of the participants were also included in the survey and the interviews.  
15 The first focus group elicited pastoralists' ways of obtaining information on the upcoming rainy  
16 season and their opinions about the accuracy and reliability of the various information channels.  
17 The group was asked about the information channels they were aware of. When participants  
18 mentioned radio, telephone, and television, pictures of these channels were presented to the group.  
19 As extension officers, the market and the village also were mentioned as information channels, the  
20 group was presented with drawings of these channels. Following this, the group was asked to rank  
21 the pictures and drawings according to accuracy and reliability. Such exercises involved people  
22 working together and the material existence of pictures and drawings of the different information  
23 channels seemed to embolden some people. For example, if the picture of a radio was at the bottom,  
24 a dissenting participant might twitch or flinch; another might articulate their dissent. Whether the

1 researcher observed a participant react physically to the ranking or a participant expressed dissent,  
2 the researcher called upon the participant to explain the response.

3

4 Another focus group aimed to explore pastoralists' understanding of the seasonal forecast. If the  
5 participants indicated that they had received seasonal forecasts for previous seasons, they were  
6 asked to discuss the 2013 forecast. If participants seemed uninformed about seasonal forecasts, an  
7 exercise was introduced to help pastoralists understand the notion of probability distribution. The  
8 exercise was similar to the one adopted in the CFAR project, where probabilities were presented by  
9 laying out differently colored slips of paper (10 blue, 10 yellow, and 5 red), and then placing them  
10 in a bowl and randomly selecting one slip of paper. The selection was repeated several times to  
11 show that the low probability scenario could occur, though with lesser frequency (for more details,  
12 see Kirshen & Flitcroft, 2000; Ingram et al., 2002). After this exercise, participants were asked, as  
13 a group, to discuss the usefulness of the seasonal forecast.

14

15 A third focus group served to determine the kind of weather, climate, and resource information  
16 pastoralists were most interested in. The group was asked to list all the possible information types  
17 they were aware of and then point out the most relevant information. Toward the end of the session,  
18 a forage supply map was presented and explained to the group, and the group was then asked to  
19 discuss the relevance of the map. The aim was not only to have a list of the most relevant  
20 information, but also to observe how participants would react when a new information type was  
21 brought forward: would participants help each other understand the map and would they try to  
22 persuade the others of their own points of view of the new information type?

23

1 Finally, a fourth focus group addressed how pastoralists may respond to various types of  
2 information. With a point of departure in the list of relevant weather, climate, and resource  
3 information made in the previous focus group, participants were asked to discuss the possible  
4 changes in herd management that could result from the information. The aim was to assess whether  
5 participants were likely to take action on the basis of the information.

6

7

## 8 **6. Analysis**

9

### 10 **6.1 The seasonal forecast**

11 In 2013, only 7% of the interviewed pastoralists in Koria received the seasonal forecast (Fig. 4) and  
12 none of them got the recommendations provided along with the forecast. The few interviewees who  
13 did get the seasonal forecast had heard it either on the national radio in French or from other  
14 villagers in Koria. As fluency in French is very limited among villagers and only 17% of the  
15 interviewed households have a radio (Fig. 3C), dissemination only by national radio will not be  
16 sufficient. This point to a lack of appropriate communication formats and channels after the  
17 termination of the CFAR project. The argument may also apply to Belgou, where no interviewees  
18 received the seasonal forecast (Fig. 4). These observations are in accordance with the findings from  
19 the one other study that assessed information needs among pastoralists, albeit in East Africa. Here  
20 Luseno et al. (2003) found that external forecasts of the total amount of rain did not reach  
21 pastoralists as most pastoralists either were not aware that forecasts were available or had no access  
22 to a radio.

23

1 It may be argued that there is simply a lack of interest among pastoralists to access the forecast.  
2 During a focus group session in Koria on the usefulness of a seasonal forecast, one pastoralist stated  
3 that *‘information on the total amount of rain gives you an idea about how well the fields will do, but*  
4 *we want to know where there is grass’*. As this claim came from an elderly participant, it seemed to  
5 embolden other participants in directing the conversation towards the problems with a seasonal  
6 forecast. Accordingly, it was mentioned that *‘the rain is never the same in all villages here. You*  
7 *need to have information from each village’*. In Belgou, the attitude towards seasonal forecasts was  
8 clear: *‘this map is for people who know how to read and write’*. Participants agreed that although  
9 the 2013 seasonal forecast had been explained verbally, the information was too complex.  
10 Moreover, participants seemed puzzled about how the information from the southern parts of  
11 Burkina Faso could be the ‘same’ as for the northern parts, and although it was explained that it was  
12 the probability distribution that was the same, not the total amount of rainfall, the participants did  
13 not seem to accept this explanation.  
14  
15 Consistent with these assertions, Ingram et al. (2002) observed that even among farmers a forecast  
16 of total seasonal rainfall is of limited use unless it includes estimates of the duration and distribution  
17 of rainfall over time and space. In order of declining priority, the most salient rainfall parameters  
18 that farmers want are 1) the timing of the onset and end of the rainy season, 2) the rainfall  
19 distribution, and 3) the total amount of rainfall (Ingram et al., 2002).  
20  
21

## 22 **6.2 Identification of weather, climate, and resource information needs among pastoralists**

23 In assessing the reach of external forecasts, it was found that 30% of the interviewed pastoralists in  
24 Koria had received two- to three-day rainfall forecasts during the 2013 rainy season (Fig. 4). The

1 forecasts were received through radio (78% of the respondents who had received a two- to three-  
2 day rainfall forecast) and television (22% of the respondents who had received a two- to three-day  
3 rainfall forecast). As with the seasonal forecast, the two- to three day forecast failed to reach any of  
4 the pastoralists in Belgou. The difference between the two villages may on the one hand be  
5 explained by a greater awareness of various types of weather, climate, and resource information in  
6 Koria due to the CFAR project, but on the other hand, it may also be attributed to very low  
7 educational levels in Belgou. While 70% of the pastoralists in Koria had attended either Koranic or  
8 elementary school, the percentage was only 45% in Belgou (Fig. 3B). When cross-referencing the  
9 information received with the educational levels, it was found that all pastoralists receiving the  
10 seasonal forecast and information on flood events through formal sources such as radio and  
11 television had attended school (Fig. 5). Of the pastoralists who received the two- to three-day  
12 rainfall forecast, which was likewise disseminated by formal sources, 89% had some years of  
13 school attendance. Information on the availability of grazing resources and the start of the rain was  
14 obtained from informal sources, such as telephone conversations and was received by pastoralists  
15 with varying educational levels. This indicated that information disseminated through formal  
16 channels was more successful in reaching pastoralists with some level of education, while the  
17 information sought for through informal channels did not depend on educational level.

18  
19 During the semi-structured interviews in Koria pastoralists said that they heard the two- to three-day  
20 rainfall forecasts on the radio or saw it on television by chance when listening to music or watching  
21 a television show with neighbors. Moreover, the pastoralists who had watched it on television said  
22 that because the information broadcast was in French, they mainly watched images. The forecast  
23 was considered of limited value as it was not really understood and more importantly, it was not  
24 necessarily watched at the time when pastoralists needed information.

1

2 During 2013, pastoralists in Koria and Belgou mainly received information pertaining to the  
3 availability of grazing resources in various areas as well as the onset date of the rains (Fig. 4). The  
4 information was primarily gained by calling friends and family in other areas on a mobile phone. At  
5 the beginning of the rainy season, the question asked was whether the rain had arrived, while the  
6 nature of the forage conditions was the main concern during the dry season. In addition to the use of  
7 mobile phones, information on the onset date of the rains was available from indigenous forecasting  
8 methods such as readings of stars, winds and fauna behavior (see also Tarhule & Lamb, 2003),  
9 whereas information on the status of the forage conditions was gained by sending scouts in advance.  
10

11 The final type of weather, climate, and resource information respondents reported having received  
12 in 2013 was related to flooding (13% of respondents in Koria and 6% in Belgou), including flood  
13 warnings as well as updates on flood impacts in Ouagadougou and elsewhere. However, as the  
14 information did not cover flooding risks or impacts specifically in northern Burkina Faso, it was  
15 perceived to consist mostly of general flood warnings.  
16

17 As highlighted by Tarhule and Lamb (2003), the information farmers receive may not conform well  
18 to the type of information they prefer to receive. In order to determine whether this also applies to  
19 pastoralists, respondents were asked to indicate the type of information they would be most  
20 interested in receiving (Fig. 6). Pastoralists in both Belgou and Koria were mainly interested in  
21 information pertaining to the availability of grazing resources in specific areas. Oursi, Yomboli,  
22 Dèou, Seytanga, and Sebba were mentioned as these areas often have good water sources such as  
23 temporary lakes during most of the dry season. Information on grazing resources was the first  
24 choice of more than 80% of the respondents in both villages, which was also the case when

1 respondents reported on the received information. In contrast, fine-scale information on the rainfall  
2 amount during the first weeks of the rainy season turned out to be the second most preferred  
3 information type, although such forecasts were not received by any of the respondents. During the  
4 semi-structured interviews, pastoralists expressed that while the first rain was important to  
5 understand when grasses would sprout, a good rain by the end of the season was mainly important  
6 for crop maturity. Hence, for pastoralists the total amount of rain as presented by the PRESAO was  
7 of less interest than the amount of rain at the beginning of the season. Moreover, it was stated that  
8 such information would only have value if it was available at a finer scale than what is currently  
9 available, which is consistent with findings among the user group of South African farmers (Archer,  
10 2003).

11

12 Two other information types of interest to pastoralists were the onset date of the rain and flood  
13 warnings. The percentage of pastoralists preferring information on the onset date was, however,  
14 slightly lower than the percentage reporting actual receipt of that information. Some respondents  
15 argued that if they were to receive fine-scale information on the amount of rain at the beginning of  
16 the rainy season, information on the onset date would be unnecessary.

17

### 18 **6.3 Application of weather, climate, and resource information**

19 A key question is how pastoralists actually react to the currently available information. The  
20 seasonal and the two- to three-day rainfall forecast seemed to have more bearing on crop cultivation  
21 strategies than on herd management strategies (Table 1). The changes in behavior included  
22 constructing stone bunds to halt the process of soil erosion (Atampugre, 1997) as above-average  
23 rain was expected and adjustments in the time of sowing the fields according to the two- to three  
24 day rainfall forecast. Although the proportion of pastoralists receiving these particular types of

1 information was rather limited, the results indicate that pastoralists did act upon it. But as the  
2 information was gained by coincidence, it could have easily been missed.  
3

4 Pastoralists seemed more inclined to change their behavior related to herd management when they  
5 received information on flooding events, the availability of grazing resources, the onset date of the  
6 rain, and the amount of rain during the first weeks of the rainy season. The information-based  
7 changes included choices of when and where to move the herds (Table 1). Such response options  
8 are consistent with literature on key pastoral management strategies (Thébaud & Batterbury, 2001;  
9 Adriansen, 1999; Dyson-Hudson & Dyson-Hudson, 1980). Information on the rainfall early in the  
10 season and on the onset date primarily influenced decisions on transhumance southwards during the  
11 very late dry season with the aim of meeting the rain. Most pastoralists receiving this information  
12 moved the herds towards the areas around Sebba, depending on where the rain had started. This  
13 type of transhumance was often of limited duration as many pastoralists returned to their village  
14 during the rainy season in order to cultivate their fields. Pastoralists without fields were more  
15 mobile at the end of the dry season and moved their herds further south.  
16

17 Information on the onset of the rainy season also shaped decisions related to the buying of  
18 supplementary fodder. Of the pastoralists who had received information on the onset either from  
19 friends and family in the more southern areas or by the use of traditional signs such as the wind,  
20 17% mentioned that if the rain was about to start, they adjusted the quantity of fodder they bought.  
21 If possible, pastoralists preferred to save money by purchasing less fodder because food shortages  
22 and high food prices are common during this time of the year.  
23



1 All the pastoralists, who reported receiving flood information, reacted by adjusting the herd  
2 composition so that the milk herd that stayed in the vicinity of the village consisted of the weakest  
3 animals, while the satellite herd on the move was composed of the strongest animals. Pastoralists  
4 said that the strong animals were more likely to avoid drowning in the mud. Another change made  
5 by all the pastoralists who had received flood information was in terms of the person herding the  
6 cattle (Table 1). Information about flooding events initiated worries about children being too small  
7 and inexperienced to herd in difficult situations. Therefore, adults took over the herding.

## 9 **7. Conclusions and policy implications**

10 Pastoralists in the Sahel can and do respond to various types of weather, climate, and resource  
11 information by enacting different strategies. However, the information they act on is primarily  
12 obtained by calling friends and family in nearby areas rather than being delivered by central  
13 authorities, such as the Climate Outlook Forum for West Africa. Thus, there seems to be a strong  
14 disconnect between the parameters and scale of information that pastoralists need and those  
15 currently provided. This disconnect becomes particularly evident when looking at the low  
16 proportion of pastoralists who have received the seasonal rainfall forecasts issued by the Climate  
17 Outlook Forum. Although an informal dissemination system characterized by discontinuities may  
18 be partly responsible for the limited use of seasonal forecasts, it is also remarkable that pastoralists  
19 responded to the forecast by adjusting their cultivation strategies rather than by using it to support  
20 livestock management decisions. Rather, a demand for other types of weather, climate, and resource  
21 information seemed to be widespread. Yet, because pastoralists lack an effective voice in weather  
22 and climate information services, the currently available products and dissemination of these remain  
23 poorly designed for pastoral needs.

24

1 There are a several feasible avenues for providing more relevant information to pastoralists:

- 2 • Information on the availability of grazing resources in various areas and flooding events  
3 should be acknowledged as highly demanded information.
- 4 • Although it remains a major challenge to predict the onset date of the rains in West Africa  
5 (Laux et al., 2008), it should be recognized that such information as well as fine-scale  
6 information on the rainfall amount during the first weeks of the rainy season is of prime  
7 importance among pastoralists.
- 8 • Methods to quantify dry season grazing resources should be developed.

9

10 However, there is also a number of constraints related to the access, the understanding, and the  
11 capacity to respond to the information among pastoralists. If weather, climate, and resource  
12 information is to be incorporated into pastoralist's adaptive decisions, we suggest that:

- 13 • A formalized system for information transfer should be established in which pastoralists  
14 must be given some kind of effective voice.
- 15 • The information should be disseminated in a proper format, e.g. orally by telephone in local  
16 languages.
- 17 • Other types of information that support the range of pastoral response options (decisions on  
18 transhumance destinations, the purchase of supplementary fodder, and herd size and  
19 composition) must be identified and provided.

20

21 Dissemination of information requires planning and coordination at various levels and across  
22 sectors. As strategies for disseminating have tended to focus on farmers, pastoralists have found  
23 their own ways of receiving information on the availability of grazing resources, i.e. by calling  
24 friends and family in nearby areas, and they are unaware of the potentially useful information

provided by AGRHYMET and other suppliers. In developing a dissemination system, attention must therefore be given to how weather, climate, and resource information can supplement rather than replace the existing system for acquiring information. For example, efforts could concentrate on the dissemination of flooding forecasts or fine-scale information on rainfall amounts during the first weeks of the rainy season as this type of information is highly demanded by pastoralists but not widely accessible.

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22  
23

**Table 1. Management changes during the 2013 season among pastoralists in Koria and Belgou when receiving different types of weather, climate, and resource information. Calculations of the percentage of pastoralists making management changes are based on the number of pastoralists who received particular types of information: seasonal precipitation forecast (n=2), two- to three-day rainfall forecast (n=9), the start date of the rain in other areas (n=48), the availability of grazing resources (n=57), and flooding events (n=6).**

Information	Changes in herd management due to the information	% of pastoralists	Changes in cultivation practices due to the information	% of pastoralists
Seasonal precipitation forecast			Construction of stone bunds as above average rain was predicted	50%
2-3 day rainfall prevision			Sowing the field	11%
The start date of the rain in other areas	Buying of supplementary fodder can be better adjusted to the start of the rain	17%		
	More qualified choices of destinations when walking towards the rain	53%		
	Destocking if the rain is late	6%		
The availability of grazing resources	More qualified choices of transhumance destinations during the dry season	75%		
Flooding events	Limited movements of the herd normally performed by children during the rainy season are undertaken by adults during heavy rains	100%	Increase the cultivated area, as some of the fields will be flooded	50%
	The herd composition in the limited movements is changed so the herd only consists of strong animals during heavy rains	100%		

Fig. 1. Seasonal forecast for 2013 delivered by the Climate Outlook Forum for West Africa. The precipitation is issued by tercile probabilities for below, near and above normal precipitation. The tercile probabilities are based on a historical precipitation record. From ACMAD et al. (2013).

Fig. 2. Map of northern Burkina Faso showing the location of Koria and Belgou

Fig. 3. A) Age distribution, B) educational attainment, and C) assets of pastoralist respondents in the two study sites (n= 31 in Belgou and n=30 in Koria).

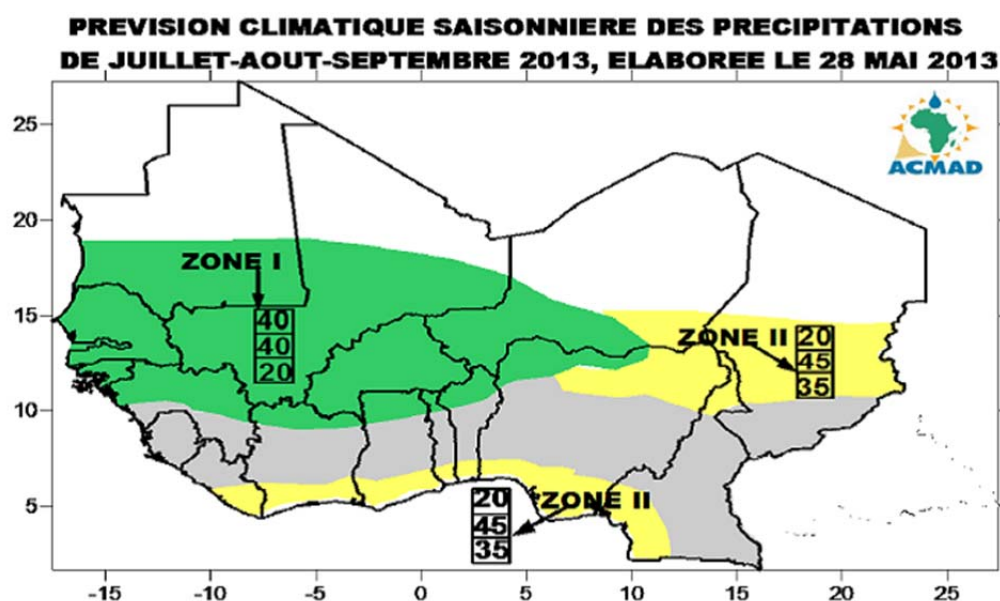
Fig. 4. Received information during the 2013 season among pastoralists (n= 31 in Belgou and n=30 in Koria). Each pastoralist received several information types. These were either obtained from formal sources (radio and television), informal sources (e.g. traditional forecasting systems) or a combination of the two.

Fig. 5. Educational attainment among pastoralists who received a seasonal forecast (n=0 in Belgou and n=2 in Koria), information on flooding events (n= 2 in Belgou and n=4 in Koria), a two- to three-day rainfall forecast (n=0 in Belgou and n=9 in Koria), information on the availability of grazing resources (n=30 in Belgou and n=27 in Koria), and starting date of the rain (n=25 in Belgou and n=23 in Koria).

Fig. 6. Preferred information among pastoralists (n= 31 in Belgou and n=30 in Koria). Each pastoralist could identify up to three distinct types of information.



Fig. 1. Seasonal forecast for 2013 delivered by the Climate Outlook Forum for West Africa. The precipitation is issued by tercile probabilities for below, near and above normal precipitation. The tercile probabilities are based on a historical precipitation record. From ACMAD et al. (2013).



**Fig. 2. Map of northern Burkina Faso showing the location of Korïa and Belgou**

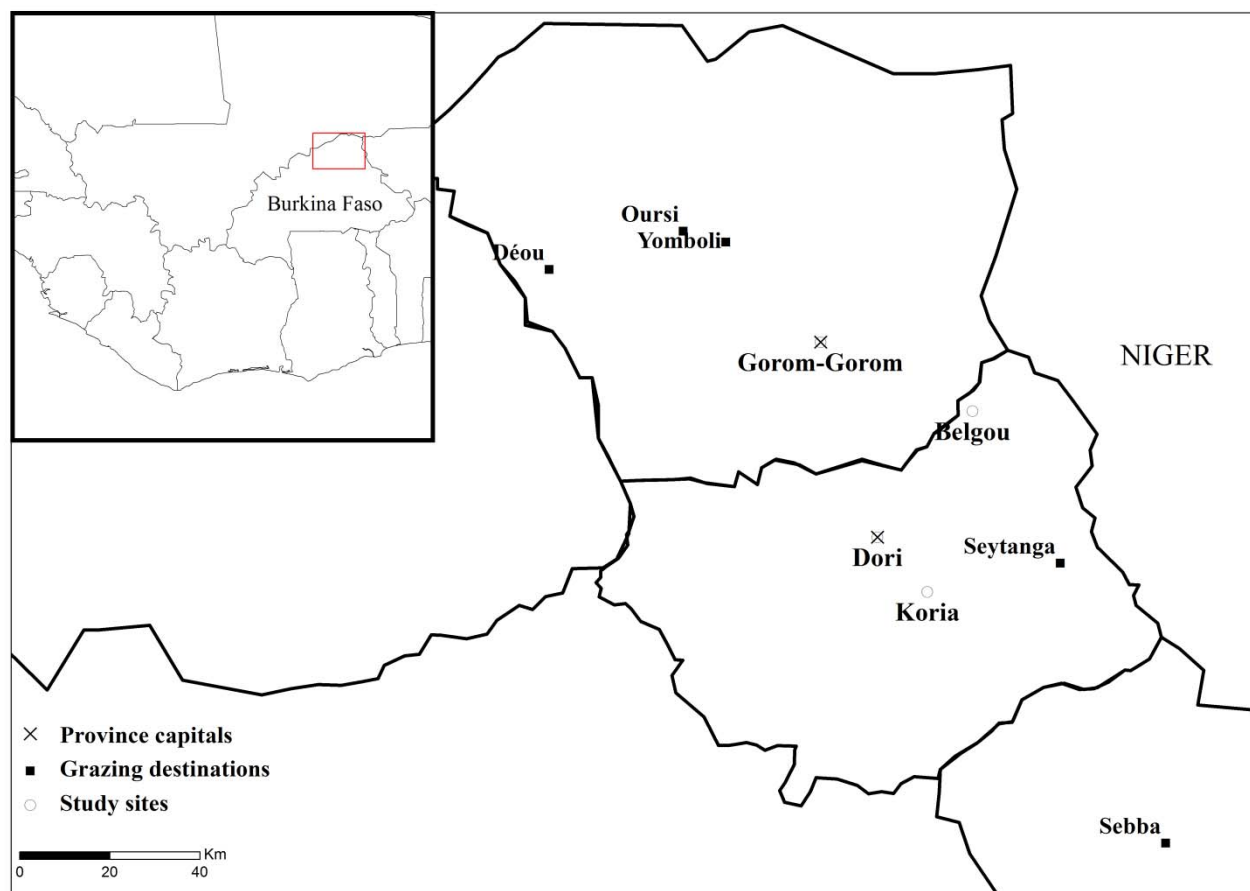


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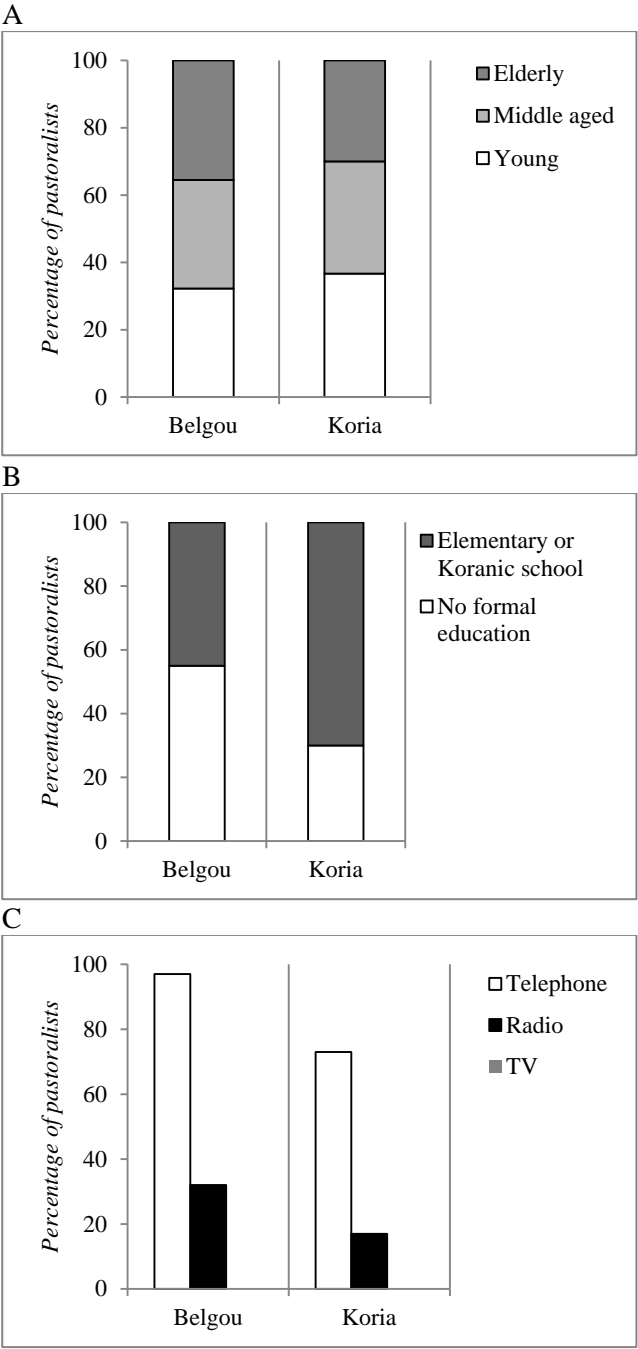


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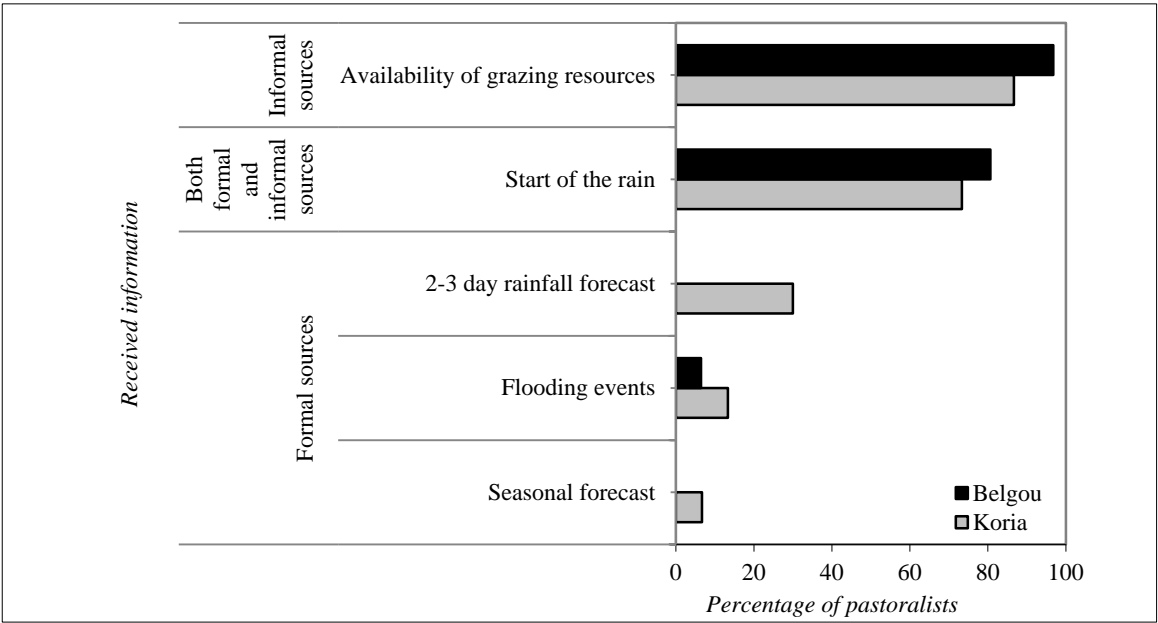


Fig. 5. Educational attainment among pastoralists who received a seasonal forecast (n=0 in Belgou and n=2 in Koria), information on flooding events (n= 2 in Belgou and n=4 in Koria), a two- to three-day rainfall forecast (n=0 in Belgou and n=9 in Koria), information on the availability of grazing resources (n=30 in Belgou and n=27 in Koria), and starting date of the rain (n=25 in Belgou and n=23 in Koria).

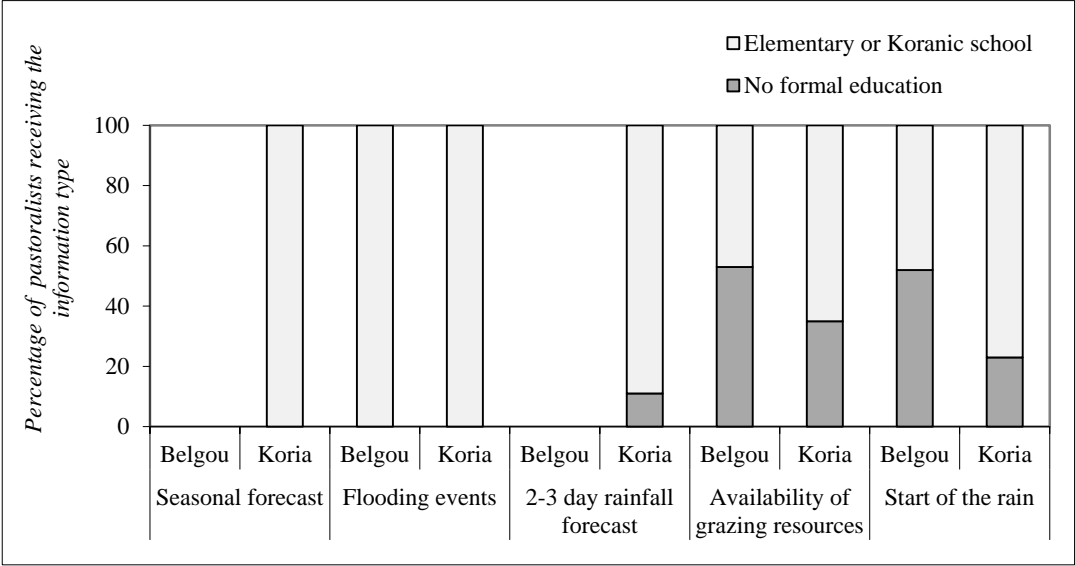


Fig. 6. Preferred information among pastoralists (n= 31 in Belgou and n=30 in Koria). Each pastoralist could identify up to three distinct types of information.

